EXECUTIVE SUMMARY

The purpose of this report is to characterize the environmental management performance of the Miamisburg Environmental Management Project (MEMP) in calendar year 2000 and to demonstrate compliance with the requirements of DOE Order 5400.1, "General Environmental Protection Program," DOE Order 5400.5, "Radiation Protection of the Public and Environment," and DOE Order 231.1, "Environment, Safety and Health Reporting." The MEMP is a government-owned site operated by BWXT of Ohio (BWXTO) for the U. S. Department of Energy (DOE). The site's historical mission included production, development, and research in support of DOE's weapon and energy related programs. The defense mission has been phased out. Current MEMP objectives include the nuclear energy program mission, environmental restoration and the transition of the site to the community for reuse as a commercial facility. As a result of economic development activities by the Miamisburg Mound Community Improvement Corporation (MMCIC), 30 private businesses are operating at the site.

MEMP is comprised of 90 structures on 280 acres of land in Miamisburg, Ohio, approximately 16 km (10 mi) southwest of Dayton. In the last two years, 26 acres of property have been transferred to MMCIC. More than 10 structures have been demolished or transferred.

The Great Miami River, which flows through the city of Miamisburg, dominates the landscape of the five-county region surrounding MEMP. The river valley is highly industrialized. The rest of the region is a mix of farmland, residential areas, small communities and light industry. Many city and township residences, five schools, the Miamisburg downtown area, and six of the city's 17 parks are located within one mile of the site. The climate is moderate. The geologic record preserved in the rocks underlying the site indicates that the area has been relatively stable since the beginning of the Paleozoic Era more than 500 million years ago. The southwestern portion of the site is located over the Buried Valley Aquifer which has been designated as a sole source aquifer by the U.S. Environmental Protection Agency (U. S. EPA).

ES.1 Accomplishments

Many accomplishments occurred in 2000, and some of these are listed below. Further details about these accomplishments are provided in the Executive Summary and in Chapters 2 – 6 of the report.

- four structures (E, 67, 68, and 88) were demolished;
- more than 125,000 pounds of hazardous waste were shipped offsite;
- almost 100,000 ft^3 of radioactive waste was shipped offsite;
- airborne tritium emissions decreased by fifty percent;
- the maximum offsite dose was 0.2% of the DOE standard;
- the population dose of 1.3 person-rem was approximately 0.00013% of total background radiation;
- over 1300 NPDES water samples were taken with only 3 exceedances;

- the average tritium concentration detected in Miamisburg drinking water was 0.8% of the U.S. EPA's maximum contaminant level (MCL);
- 83 CERCLA documents were submitted to regulators and stakeholders;
- 96 potential release site (PRS) decisions were recorded;
- approximately 30 CERCLA meetings were held with regulators.

ES.2 Perspective on Radiation

Radionuclides emit ionizing radiation. Ionizing radiation is radiation possessing enough energy to remove electrons from the substances through which it passes. Most consequences to humans from exposure to radionuclides arise from the interactions of ionizing radiation with human tissue. These interactions are measured based on the amount of energy deposited in the tissue. This value is the absorbed dose. Since different types of ionizing radiation cause different degrees of biological harm, it is necessary to weight the doses to account for those differences. The unit used to make this comparison possible is the dose equivalent. The units used to report dose equivalents are the rem and the Sievert (Sv). Because doses associated with environmental exposures are typically only fractions of a rem or Sievert, it is common to report doses in terms of millirem (mrem) or millisievert (mSv). There are 1000 mrem per rem; 1000 mSv per Sv.

Our bodies are exposed to ionizing radiation each day. Most of this radiation comes from natural sources. The average dose to a resident of the United States from natural sources is about 300 mrem (3 mSv) per year. The primary contributors to this background dose are radon, cosmic and terrestrial sources, and medical sources such as x-rays or diagnostic exposures. A summary of the principles of radiation can be found in Appendix F of this Report.

ES.3 Radionuclide Releases from MEMP

Table ES-1 lists the quantities of radionuclides released by MEMP into the air and surface water during 2000. The unit used to report these quantities is the curie (Ci), a unit of radioactivity equal to 3.7×10^{10} disintegrations per second. The quantities, or activities, shown in Table ES-1 were measured at the point of release.

Table ES-1. Radiological Effluent Data for 2000

Radionuclide	Released to	Activity, Ci	MEMP Range[b], Ci
Tritium	Air	3.8×10^{2} [a]	$3.8 \times 10^{2} - 8.0 \times 10^{2}$
	Water	1.7	1.7 – 2.5
Plutonium-238	Air	9.4×10^{-6}	$6.9 \times 10^{-6} - 4.5 \times 10^{-5}$
	Water	1.6×10^{-4}	$1.6 \times 10^{-4} - 4.8 \times 10^{-4}$
Plutonium-239,240	Air	3.6×10^{-8}	$2.0 \times 10^{-8} - 1.0 \times 10^{-7}$
	Water	2.4×10^{-6}	$1.7 \times 10^{-6} - 3.6 \times 10^{-6}$
Radon-222	Air	3.2	$5.5 \times 10^{-1} - 3.2$
Uranium-233,234	Air	1.8×10^{-8}	$8.0 \times 10^{-9} - 9.2 \times 10^{-8}$
	Water	3.4×10^{-4}	$3.4 \times 10^{-4} - 3.9 \times 10^{-4}$
Uranium-238	Air	1.1×10^{-8}	$4.0 \times 10^{-9} - 1.1 \times 10^{-8}$

[a] Tritium released to air consists of: Tritium oxide, 3.10×10^{2} Ci
Elemental tritium, 7.33×10^{1} Ci

[b] Minimum – Maximum (CY1996 – CY2000)

ES.4 Dose Limits

Dose limits, or more precisely, dose equivalent limits, for members of the public are presented in Table ES-2. These limits are expressed in terms of a committed effective dose equivalent (CEDE) and an effective dose equivalent (EDE) for the DOE and U. S. Environmental Protection Agency (EPA), respectively. Values shown in Table ES-2 represent annual limits on dose equivalents established by the DOE and EPA.

Table ES-2. Radiation Dose Limits for Protection of the Public from all Routine DOE Operations

Pathway	Regulatory Standard or Driver	Effective Dose Equivalent[a] mrem	mSv
All exposure media	DOE Order 5400.5	100	1
Air	40 CFR 61 (EPA)	10	0.1
Drinking water	40 CFR 141 (EPA)	4	0.04

[a] Annual Dose Limits

ES.5 Doses from MEMP Operations

In calculating the maximum dose received by a member of the public from MEMP activities, a committed effective dose equivalent is used. The CEDEs are the doses received by a hypothetical adult individual who remained at the site boundary 24 hours per day throughout 2000. This individual was assumed to have:

- breathed exclusively air with radionuclide concentrations corresponding to the location of the maximum dose,
- drawn all of his drinking water from the Miamisburg water supply,
- consumed produce exhibiting the maximum average radionuclide concentrations in samples collected from the Miamisburg area.

The CEDEs from all of these pathways are added to obtain an estimate of the maximum CEDE received by this hypothetical individual. Table ES-3 shows the results for MEMP in 2000. CEDEs for tritium, plutonium-238, plutonium-239, 240, thorium-228, thorium-230, and thorium-232 were calculated. Concentrations of other radionuclides were below background levels or were too small to affect the overall dose.

Table ES-3. Maximum Committed Effective Dose Equivalents to a Hypothetical Individual in 2000

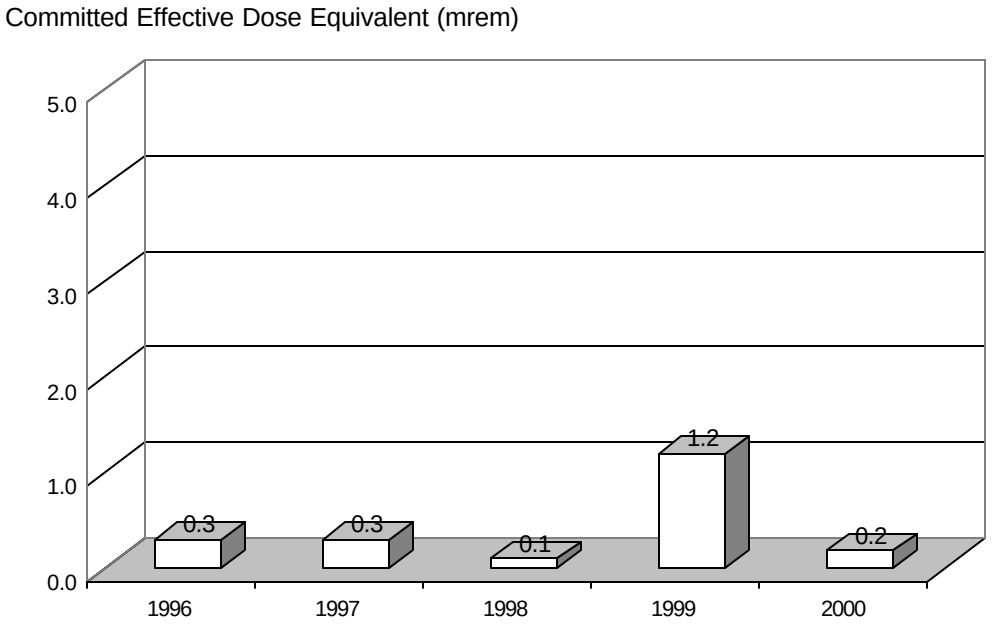
Radionuclide	Pathway	mrem	mSv
Tritium	Air	0.003	0.00003
	Drinking water	0.007	0.00007
	Foodstuffs	0.0007	0.000007
	Total	0.011	0.00011
Plutonium-238	Air	0.026	0.00026
	Drinking water	ND	ND
	Foodstuffs	ND	ND
	Total	0.026	0.00026
Plutonium-239,240	Air	ND	ND
	Drinking water	ND	ND
	Foodstuffs	0.007	0.00007
	Total	0.007	0.00007
Thorium-228	Air	0.019	0.00019
	Drinking water	ND	ND
	Foodstuffs	NA	NA
	Total	0.019	0.00019
Thorium-230	Air	0.024	0.00024
	Drinking water	0.001	0.00001
	Foodstuffs	NA	NA
	Total	0.025	0.00025
Thorium-232	Air	0.089	0.00089
	Drinking water	ND	ND
	Foodstuffs	NA	NA
	Total	0.089	0.00089
Total		0.177	0.00177

ND indicates that concentrations were not detectable above the environmental level or reagent blanks.
NA = not applicable (not measured).

The data presented in Table ES-3 were calculated using environmental monitoring data measured at and near the site. MEMP also evaluates doses using the EPA's computer code CAP88-PC. CAP88-PC uses air effluent data as input to transport, dispersion, and dosimetry codes. By executing these codes, one generates an estimate of a maximum offsite dose from airborne releases. For 2000, the CAP88-PC-estimated maximum offsite dose was 0.03 mrem at a location 900 meters north-northeast of the HEFS stack. As reported in Table ES-2, the EPA's annual dose limit for airborne releases is 10 mrem. Therefore, MEMP releases in 2000 represented 0.3% of the dose limit set by the EPA.

Figure ES-1 shows the five year trend in CEDEs. The doses from MEMP activities in 1996-2000 were small fractions of the 100 mrem per year DOE dose limit for members of the public. Most of the 1999 CEDE was due to one set of vegetation samples. These samples had measurable, although very low, levels of Pu-238 that were greater than observed at other locations in previous years.

Figure ES-1. Calculated CEDEs from MEMP Activities, 1996 - 2000



Population doses. CAP88-PC also has the capability of estimating regional population doses from airborne releases. The population, approximately 3,126,615 persons, within a radius of 80 km (50 mi) of MEMP received an estimated 1.3 person-rem from site activities in 2000. CAP88-PC arrived at that value by calculating doses at specific distances and in specific compass sectors relative to MEMP. The computer code then multiplied the average dose in a given area by the number of people living there. For example, an average dose of 0.001 rem x 10,000 persons in the area yields a 10 person-rem collective dose for that region. CAP88-PC then sums the collective doses for the 80-km radius region and reports a single value. Additional dose components from drinking water and radon emissions are added to obtain this result.

MEMP's dose contribution of 1.3 person-rem can be put in perspective by comparison with background doses. The average dose from background sources is 300 mrem (0.3 rem) per individual per year. A background collective dose can be estimated for the 80-km population by multiplying 0.3 rem x 3.127 million persons. The result, about one million person-rem, represents an estimate of the collective dose from all background sources of ionizing radiation. MEMP's contribution is approximately 0.00013% of that value.

ES.6 Environmental Monitoring Program Results

Besides setting limits on the CEDE to any member of the public, DOE has established Derived Concentration Guides (DCGs) for individual radionuclides. The DCG is defined as the concentration of a radionuclide in air or water that will result in a CEDE of 100 mrem (1 mSv) following continuous exposure for one year. The concentrations of radionuclides resulting from MEMP's 2000 releases were small fractions of the corresponding DCGs (see Chapter 4).

Radiological Monitoring of the Atmosphere

Ambient air is sampled for tritium and plutonium by an onsite network of eight perimeter stations and by an offsite network of 12 stations (see Figures 4-4 and 4-5). Eleven of the offsite samplers are located in the Miamisburg area. One sampler is located far enough away to receive virtually no impact from MEMP activities. This sampler serves as a reference location to establish background or environmental levels of tritium, plutonium, and thorium. The amount by which a sample exceeds the background or environmental level is reported as an incremental concentration.

In 2000, average incremental concentrations measured at the onsite samplers were less than 0.0045% of the DOE DCG for tritium oxide, and less than 0.095% of the DOE DCGs for plutonium-238, plutonium-239, thorium-228, thorium-230, and thorium-232.

Radiological Monitoring of Water

Water samples were collected from locations along the Great Miami River and were analyzed for tritium, plutonium-238, plutonium-239,240, uranium-233,234, uranium-238, thorium-228, thorium-230, and thorium-232. Other surface water locations were sampled for tritium and plutonium. Additionally, river sediment samples were analyzed for isotopes of plutonium and thorium.

River water. Over 300 samples were collected. Average tritium concentrations in the river were less than 0.065% of the DOE DCG for tritium in water. The average incremental concentrations of plutonium-238 and plutonium-239,240 in water from the Great Miami River were less than 4.02% of the DCGs. The average incremental concentrations of uranium-233,234 and uranium-238 were below the environmental level. Average incremental thorium-228, thorium-230 and thorium-232 concentrations were less than 0.035% of the DOE DCGs.

Pond Water. Eighteen samples from local ponds were analyzed for tritium, plutonium-238, and plutonium-239,240. Incremental concentrations of tritium were not detectable above environmental levels. Incremental concentrations of plutonium-238 and plutonium-239,240 were below 0.045% of the DCGs.

Sediment. One hundred fifty samples were collected. Plutonium and thorium results for river and pond sediments are listed in Appendix B, Tables B-14 through B-19. Maximum and average concentrations for 2000 are comparable to concentrations observed in previous years. Since isotopes of plutonium and thorium tend to accumulate in sediment, concentrations are affected by the movement of silt. This accounts for the variability in plutonium concentrations at the various river and pond locations.

Radiological Monitoring of Foodstuffs

Over thirty samples of locally-grown produce were collected from the surrounding area. These samples were then analyzed for tritium and/or plutonium as appropriate. Average incremental concentrations of tritium, plutonium-238, and plutonium-239,240 were below 0.055×10^{-6} μCi/g. Average incremental concentrations in 2000 were lower than those in 1999.

Nonradiological Monitoring of Air

Particulate loadings are measured at all of the onsite and offsite air sampling locations. Particulate concentrations appeared to be independent of distance. This result suggests that MEMP exerts little or no influence on the levels of airborne particulates in the ambient environment.

Nonradiological Monitoring of Water

MEMP's nonradiological liquid discharges are regulated by an National Pollutant Discharge Elimination System (NPDES) permit and Authorization to Discharge (ATD). In 2000, over 1,300 samples were collected to demonstrate compliance with these permits. Of these, three results exceeded the permit limitations for total suspended solids (TSS) due to excessive rainfall and a stormwater barrier failure.

The Ohio EPA issued a Notice of Violation (NOV) for Outfall 602 regarding acute biotoxicity. The acute biotoxicity was due to elevated levels of chlorine during Ohio EPA's permit renewal sampling. No ATD exceedances occurred in 2000. No enforcement actions were initiated in 2000. Additional information about NPDES and ATD results for 2000 can be found in Chapter 5.

ES.7 Groundwater Monitoring Program

MEMP maintains an extensive network of onsite and offsite monitoring wells. In addition, a number of onsite production wells and offsite community water supplies are routinely sampled. Drinking water from MEMP and the Miamisburg area is analyzed for tritium and isotopes of plutonium, uranium, and thorium. Other regional water supplies are sampled for tritium since it is the most mobile of the radionuclides released from the site. Tritium levels in onsite production wells have consistently been less than 1 nCi/L. Average tritium concentrations from monthly samples collected from seven community water supplies and six private wells ranged from nondetectable to 0.17 nCi/L, or less than 1.0% of the MCL. Results for 2000 are shown in Appendix D, Table D-2 and D-12. The results reflect the pattern of tritium concentrations one would expect: higher averages near the site (e.g., Miamisburg) and lower averages at greater distances (e.g., Middletown).

The SDWA does not limit the concentrations of most radionuclides individually (tritium is an exception). Instead, the dose from specific combinations of radionuclides is limited to 4 mrem/year. In 2000, the dose from plutonium, uranium, and thorium measured in the onsite production wells was 0.08 mrem. This represents 2.0% of the dose standard.

Monitoring wells are analyzed for various constituents including radionuclides, volatile organic compounds, metals, and inorganic cations and anions. As in previous years, monitoring data collected in 2000 indicated that volatile organic compounds and tritium, respectively, are the primary nonradiological and radiological contaminants of concern. Since the implementation of the OU1 treatment systems, monitoring and production wells have generally seen a decline in VOC concentrations as evident of the five-year trend for Production Well 0076 as shown in Figure 6-9 of Chapter 6.

In addition to the historical contaminants, trihalomethanes (THMs) have been detected in offsite and onsite monitoring wells. THMs are generally considered disinfection-by-products from chlorination. Chlorinated potable water from the City of Miamisburg leaked past a failed valve at the old Miamisburg Well #2 into the aquifer for approximately nine months before the leak was found. Information about groundwater monitoring results for 2000 can be found in Chapter 6 and Appendix D.

ES.8 Environmental Restoration

MEMP was designated a Superfund site, i.e., placed on the National Priorities List, in November of 1989. A Federal Facilities Agreement (FFA) between the DOE and the U. S. EPA followed in October of 1990. The FFA was expanded to a tri-party agreement in 1993 when the Ohio EPA became a signatory. The purpose of the FFA remains unchanged; it defines the responsibilities of each party for the completion of Superfund-related (CERCLA-related) activities. Highlights of the environmental restoration program during 2000 are described in Chapter 3 of this report.

ES.9 Quality Assurance for Environmental Data

To ensure the reliability of environmental data, MEMP maintains an internal quality assurance (QA) program that consists of running blanks, internal standards, and replicate samples. MEMP also participates in comparison exercises with external laboratories to further validate MEMP's environmental results. Comparisons of MEMP's performance with that of other laboratories are shown in Chapter 7 of this report. The close agreement between MEMP and the external labs provides confidence that MEMP's Environmental Monitoring Program generates reliable data.